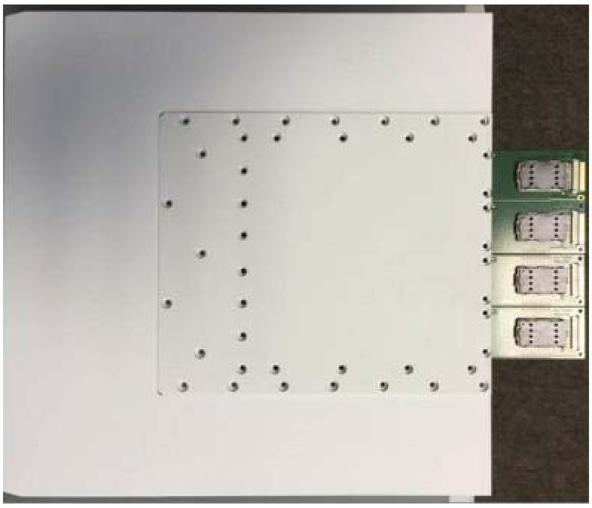

Figure 1. The array prototype inserted in a RW3 phantom adapter.

Results: Response reproducibility, short term stability and linearity with dose are those typical of ionization chamber based detectors. Maximum deviation of approximately 1.5% in sensitivity was observed in the range 0.1 – 2.5 mGy/pulse. For all different clinical evaluations, the array was found to be in very good agreement with the reference detectors. Dose distributions with steep gradients are very well defined due to the 4 mm spatial resolution and to the limited effect of volume averaging. Additionally, good agreement was observed between the expected dose from TPS and the measurements. Moreover, the detector insensitivity on dose per pulse in conjunction with the low energy dependence typical of ionization chambers lead to high performance even when therapy beams feature extremely modulated dose rates.

Conclusion: After an extensive clinical investigation the ion chamber array technology under investigation has been proven to be valuable for patient plan quality assurance, especially when highly modulated fields are used, including unflattened beams.

EP-1498

LET dependence of the PTW-60019 microDiamond detector response in particle beams

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Purpose or Objective: This work describes investigations that were carried out to assess the effect of the linear energy transfer (LET) on the response of a new synthetic single crystal diamond detector. The investigations were performed comparing the response of a PTW-60019 microDiamond detector (μD) to the response of ionization chambers (IC).

Material and Methods: Two experimental sessions were performed in mono-energetic particle beams. Using a μD with its axis parallel to the beam axis, its response was compared to the response of a Roos type IC in a 60 MeV proton beam and a Markus IC in a 62 MeV/n carbon ion beam. For both experimental sessions, the beam was monitored using an IC placed in front of the detector under investigation. As recommended by IAEA TRS-398, the response of the IC was corrected for temperature, pressure, polarity and ion recombination effects. The latter was studied during experimental sessions, using two IC positioned face to face, under the same experimental conditions as for the comparison with the μD. The experimental procedure for the determination of the recombination effects consisted of changing the voltage applied to the IC under investigations and studying the saturation curve. The determination of the recombination effect was performed at different depths. No correction was applied to the response of the μD.

Results: In the proton beam, two different values for the ion recombination correction factor (*ks*) were used to correct the response of the Roos IC: *ks* = 1.0035 in the plateau region, and *ks* = 1.004 in the Bragg Peak region. In carbon ion beam, *ks* varies from 1.01 at the entrance of the plateau and it increases slightly in the plateau region and strongly in the Bragg Peak region due to the increase of the LET, to reach 1.06 in the distal edge region.
For both beams, comparison between the responses of both detectors shows a good agreement in the plateau region. In proton beam, considering the uncertainties, no significant difference between both detectors is observed in the Bragg Peak region. The combined relative standard uncertainty of the results is estimated to 0.28% in the plateau region and 14% in the distal edge region. These values are dominated by the uncertainty of range determination. In the carbon ion beam, an under response of the μD of 20% is observed in the Bragg Peak region. The combined relative standard uncertainty of the results is estimated to 2.3% in the plateau region and 12% in the distal edge region. These values are dominated by the uncertainty of alignment in the non-uniform beam and the uncertainty of range determination.

Conclusion: Results were obtained for one particular detector only. However, confirmed by other publications, we can conclude that the LET-independent response in clinical proton beams is a characteristic of the PTW-60019 μD. This conclusion has to be investigated in more details for the carbon ion beams, for which our study show that the detector should not be assumed to be LET independent.

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GEANT4 Monte-carlo simulations for the luminescence properties of Gd2O3:Eu scintillator

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Purpose or Objective: In an indirect radiation detector modeling using Monte-carlo methods, a scintillator modeling that has same luminescence properties with a measured data is firstly performed. Therefore, in this study, we compared the measured and calculated properties of scintillator and we tried to verify an effectiveness of GEANT4 code for the scintillator modeling.

Material and Methods:
1) synthesis of scintillator
In this study, to measure the luminescence properties, we synthesized Gd2O3:Eu used as a radiation conversion material using low-temperature solution combusition method. The properties of the synthesized scintillator were obtained by measuring photoluminescence spectrum and the decay time using a PL spectrometer. For the measurement of photoluminescence spectrum, 254nm UV light generated from a xenon(optical photon) lamp was used to excite the phosphor; then, the emitted light was obtained through a monochromator and PMT.
2) Monte-carlo simulations
In this study, GEANT4 code was used for the scintillator modeling. To reduce error rate, we use 70kVp energy spectrum and an optical and scintillator physics process were used. An energy range of the scintillator were defined based on measured data. For an effective simulation, we only